

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
4 October 2001 (04.10.2001)

PCT

(10) International Publication Number
WO 01/73530 A2

- (51) International Patent Classification⁷: **G06F 1/00**
- (21) International Application Number: **PCT/US01/09631**
- (22) International Filing Date: **26 March 2001 (26.03.2001)**
- (25) Filing Language: **English**
- (26) Publication Language: **English**
- (30) Priority Data:
09/536,203 **27 March 2000 (27.03.2000)** **US**
- (71) Applicant: **SECURIT-E-DOC, INC.** [US/US]; 1689 Forum Place, West Palm Beach, FL 33401 (US).
- (72) Inventor: **BARRON, Robert, H.**; 1025 Morse Blvd., Singer Island, FL 33404 (US).
- (74) Agent: **SLAVIN, Michael**; McHale & Slavin, P.A., 4440 PGA Blvd., Suite 402, Palm Beach Gardens, FL 33410 (US).
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— *without international search report and to be republished upon receipt of that report*
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: **METHOD, APPARATUS, AND SYSTEM FOR SECURE DATA TRANSPORT**

(57) Abstract: A platform allowing for the secure file transfer from one location to another (internet or intranet) with virtually impregnable encryption, secure data storage, and a simple web-based user interface. A user accesses the system by a data-base authentication system requiring user name and password. The program residing on the server then generates an encryption sequence. A temporary file is created on the users' machine upon which the user uploads the information to be sent. The information is automatically encrypted by the program and transferred to the server and the user's temporary file deleted. The information is securely stored in the program on the server until the recipient downloads it. The recipient also accesses the server by a user name and password. The program generates a decryption program. The recipients machine receives the applet program to decrypt the file and a copy of the encrypted file. After decryption is complete, the program saves the files to a specified recipient folder, and can be automatically deleted or archived.

WO 01/73530 A2

-1-

1 **METHOD, APPARATUS, AND SYSTEM FOR SECURE DATA TRANSPORT**2 FIELD OF THE INVENTION

3 This invention relates generally to the field of data
4 transmission over computer networks and more particularly
5 to a universally adaptable server-side software system for
6 an automatically encrypted and decrypted, password
7 controlled secure transfer of data from a source host to a
8 destination host across any internetwork.

10 BACKGROUND OF THE INVENTION

11 In recent years, the widespread adoption of public
12 and private networks has modernized the manner in which
13 organizations communicate and conduct business. Advanced
14 networks provide an attractive medium for communication
15 and commerce because of their global reach, accessibility,
16 use of open standards, and ability to permit interactions
17 on a concurrent basis. Additionally, networks allow
18 businesses a user-friendly, low cost way to conduct a wide
19 variety of commercial functions electronically.

20 A computer network is basically a collection of
21 computers that are physically and logically connected
22 together to exchange data or "information." The network
23 may be local area network, connected by short segments of
24 ethernet or to the same network hub, or wide area network,
25 separated by a considerable distance. An internetwork is
26 a network of computer networks, of which the Internet is
27 commonly acknowledged as the largest.

28 The Internet is based on standard protocols that
29 allow computers to communicate with each other even if
30 using different software vendors, thus allowing anyone
31 with a computer easy accessibility to everything else
32 connected to the Internet world wide. As a result of this
33 global access, it is becoming increasingly useful for
34 businesses and individuals to transmit information via
35 networks and internetworks from one site to another.

-2-

1 The interconnected computers exchange information
2 using various services, for example, the World Wide Web
3 (WWW) and electronic mail. The WWW created a way for
4 computers in various locations to display text that
5 contained links to other files. The WWW service allows a
6 server computer system (Web server or Web site) to send
7 graphical Web pages of information to a remote client
8 computer system. The remote client computer system can
9 then display the Web pages.

10 In a standard e-mail system, a user's computer is
11 connected to a provider of Internet services, and the
12 user's computer provides an e-mail password when polling
13 the provider's computer for new mail. The mail resides on
14 the provider's computer in plain text form where it can be
15 read by anyone. In both examples, the information, if
16 unsecured, is replicated at many sites in the process of
17 being transmitted to a destination site and thereby is
18 made available to the public.

19 Organizations are increasingly utilizing these
20 networks, to improve customer service and streamline
21 business communication through applications such as e-
22 mail, messaging, remote access, intranet based
23 applications, on-line support and supply chain
24 applications. The very openness and accessibility that
25 has stimulated the use of public and private networks has
26 also driven the need for network security.

27 Presently, to provide for a secure transfer of
28 information, it may be encrypted at the sending host's end
29 and decrypted at the receiver's end. Encryption
30 algorithms transform written words and other kinds of
31 messages so that they are unintelligible to unauthorized
32 recipients. An authorized recipient can then transform
33 the words or messages back into a message that is
34 perfectly understandable. Currently, there are two basic
35 kinds of encryption algorithms (1) symmetric key

-3-

1 algorithms and (2) public key algorithms.

2 Symmetric (or private) key algorithms use the same
3 key to encrypt and decrypt the message. Generally, they
4 are faster and easier to implement than public keys.
5 However, for two parties to securely exchange information,
6 those parties must first securely exchange an encryption
7 key. Examples of symmetric key algorithms include DES,
8 DESX, Triple-DES, Blowfish, IDEA, RC2, RC4, and RC5.

9 Public key algorithms use one key (public key) to
10 encrypt the message and another key (private key) to
11 encrypt it. The public key is made public and is used by
12 the sender to encrypt a message sent to the owner of the
13 public key then the message can only be decrypted by the
14 person with the private key. Unfortunately, public keys
15 are very slow, require authentication, and do not work
16 well with large files.

17 A third type of system is a hybrid of the public and
18 private systems. The slower public key cryptography is
19 used to exchange a random session key, which is then used
20 as the basis of a symmetric (private) key algorithm. The
21 session key is used only for a single encryption session
22 and is then discarded. Nearly all practical public key
23 cryptography implementations in use today are actually
24 hybrid systems.

25 Finally, message digest functions are used in
26 conjunction with public key cryptography. A message
27 digest function generates a unique pattern of bits for a
28 given input. The digest distills the information
29 contained in a file into a single large number, typically
30 128 and 256 bits in length. The digest value is computed
31 in such a way that finding an input that will exactly
32 generate a given digest is computationally infeasible.

33 Message digest algorithms are not used for encryption
34 or decryption but for creation of digital signatures,
35 messages authentication codes (MAC), and the creation of

-4-

1 encryption keys from passphrases. For example, Pretty
2 Good Privacy (PGP) uses message digests to transform a
3 passphrase provided by a user in to an encryption key that
4 is used for symmetric encryption. (PGP uses symmetric
5 encryption for its "conventional encryption" function as
6 well as to encrypt the user's private key). A few digest
7 in use are HMAC, MD2, MD4, MD5, SHA, and SHA-1.

8 Working cryptographic systems can be divided into two
9 categories; (1) programs and protocols that are used for
10 encryption of e-mail messages such as PGP and S/MIME and
11 (2) cryptographic systems used for providing
12 confidentiality, authentication, integrity, and
13 nonrepudiation in a network environment. The latter
14 requires real-time interplay between a client and a server
15 to work properly. Examples include Secure Socket Layer
16 (SSL) a general-purpose cryptographic protocol that can be
17 used with any TCP/IP service and PCT a transport layer
18 security protocol for use with TCP/IP service, PCT, S-
19 HTTP, SET, Cybercash, DNSSEC, Ipsec, IPv6, Kerberos, and
20 SSH.

21 Although the present means of securing the electric
22 transfer of information provides a level of security, the
23 security provided can be easily breached. Symmetric
24 encryption algorithms are vulnerable to attack by (1) key
25 search or brute force attacks, (2) cryptanalysis, and (3)
26 systems-based attacks. First, in a key search, the cracker
27 simply tries every possible key, one after another, until
28 the he/she is allowed into the system or the ciphertext is
29 decrypted. There is no way to defend against this but a
30 128 bit key is highly resistant because of the large
31 number of possible keys to be tried.

32 Second, in cryptanalysis, the algorithm can be
33 defeated by using a combination of sophisticated
34 mathematics and computer power. Many encrypted messages
35 can be deciphered without knowing the key. Finally, the

-5-

1 cryptographic system itself is attacked without actually
2 attacking the algorithm.

3 Public key algorithms are theoretically easier to
4 attack than symmetric key algorithms because the attacker
5 has a copy of the public key that was used to encrypt the
6 message. Also, the message presumable identifies which
7 public key encryption algorithm was used to encrypt the
8 message. These attacks are (1) factoring attacks and (2)
9 algorithmic attacks. First, factoring attacks attempt to
10 derive a private key from its corresponding public key.
11 This attack can be performed by factoring a number that is
12 associated with the public key.

13 Second, an algorithm attack consists of finding a
14 fundamental flaw or weakness in the mathematical problem
15 on which the encryption system is based. Although not
16 often done, it has been accomplished.

17 Message digest functions can be attacked by (1)
18 finding two messages-any two messages-that have the same
19 message digest and (2) given a particular message, find a
20 second message that has the same message digest code.

21 Thus, what is needed is a system for securing the
22 electronic transfer of information that circumvents
23 decryption. Also, needed is one system that can be used
24 for both e-mail and internet security. Finally, needed is
25 a widely available, user-friendly system for securing
26 electronic transfer and storage of information.

27

28 SUMMARY OF THE INVENTION

29 The present invention provides a universally
30 adaptable server-side software system designed to
31 administrate access and facilitate virtually impregnable
32 security for the delivery, storage, and sharing of
33 documents and files utilizing any compatible network as a
34 secure communications forum.

35 In general, the instant invention is a method and

-6-

1 apparatus for encrypting data with a either a random
2 automatic mode of encryption, and a client selected
3 private key, that does not travel with the document. The
4 method and apparatus, writes the encryption algorithm
5 creating a packaged application. The encryption program
6 generates random sequences or encryption algorithms, with
7 respect to time sensitivity, to be used in the packaged
8 application that it creates. No two algorithms will ever
9 be the same.

10 In the basic embodiment, the client accesses the
11 server using a data-base authentication system requiring
12 User name and Password. Once access is granted, the
13 packaged application is sent to the client machine as a
14 temporary file to encrypt the files being sent or uploaded
15 to the server. The application package breaks the files
16 down into binary form, reads the binary form, and then
17 rewrites the data to the temporary file it created. On a
18 binary level, the code is rewritten and saved for transfer
19 in a file format only decodable by the end recipient.
20 Once this process is complete, the application packet then
21 sends the encrypted data to the server via SSL protocol
22 connection.

23 The data resides on the server waiting for an
24 intended recipient to download and unlock it. When file
25 retrieval is requested, the server authenticates the user
26 and password via a log-on system. Once access is granted,
27 the server generates a new application packet designed to
28 decrypt the file being requested, based on the original
29 encryption algorithm. The server retrieves its original
30 entry, sets into motion the sequence of creating a
31 decryption program, saves the generated program, and then
32 sends the application packet to the requesting client
33 machine.

34 The client machine receives the application packet to
35 decrypt the file from the server and a copy of the file to

-7-

1 be decrypted is downloaded. The application program now
2 runs the calculations it needs to decrypt the data with
3 the sequence it was given. The application program opens
4 the file, reads the binary data, and writes the data to a
5 new temporary file created for its reception. When the
6 file is decrypted, the program saves the file to a folder
7 specified by the recipient and then deletes itself
8 providing a secure transfer. Upon completion of the
9 transfer, the original encrypted file located on the
10 server can be deleted or retained archival.

11 Accordingly, it is an objective of the instant
12 invention to provide a method and apparatus that provides
13 secure electronic transfer of information by using a
14 random and automatic mode of encryption wherein no two
15 algorithms are ever repeated.

16 Still another objective of the instant invention to
17 provide a method and apparatus that allows for secure data
18 transportation that encrypts at the 128 bit level,
19 transports and stores data encrypted, and decrypted only
20 to an authorized user.

21 A further objective of the instant invention to
22 provide a basic level of security wherein data is
23 transported via an SSL protocol and automatically
24 encrypted. In this mode only authorized user on a network
25 can decrypt data for review or modification. Separately
26 and in addition, a secure e-mail notification is
27 dispatched to the intended recipient(s) to inform them of
28 secure data waiting for retrieval.

29 Another objective of the instant invention to provide
30 a heightened level of security wherein a private and
31 secondary key or digital file lock can be employed
32 providing a unique secondary data lock.

33 Still another objective of the instant invention to
34 provide a client-side locking device or biometric
35 interface. In such a locking device, a retinal scanner,

-8-

1 finger print scanner, smart card reader or the like and be
2 implemented in order to send or retrieve information.

3 Yet another objective of the instant invention is to
4 provide virtually impregnable security for the delivery,
5 storage, and sharing of documents and files utilizing any
6 compatible network as a secure communications forum.

7 Other objects and advantages of this invention will
8 become apparent from the following description taken in
9 conjunction with the accompanying drawings wherein are set
10 forth, by way of illustration and example, certain
11 embodiments of this invention. The drawings constitute a
12 part of this specification and include exemplary
13 embodiments of the present invention and illustrate
14 various objects and features thereof.

15

16 BRIEF DESCRIPTION OF THE FIGURES

17 Figure 1 is a block diagram of the client file
18 encryption transfer request of the instant invention;

19 Figure 2 is a block diagram of the encryption
20 transfer;

21 Figure 3 is a block diagram of the recipient file
22 request; and

23 Figure 4 is a block diagram of the decryption
24 transfer.

25

26 DETAILED DESCRIPTION OF THE INVENTION

27 Although the invention will be described in terms of
28 a specific embodiment, it will be readily apparent to
29 those skilled in this art that various modifications,
30 rearrangements, and substitutions can be made without
31 departing from the spirit of the invention. The scope of
32 the invention is defined by the claims appended hereto.

33 Now, referring to Fig. 1, shown is flow chart
34 depicting the steps required for encrypting data allowing
35 for secure transfer of electronic data. A client 10 opens

-9-

1 a web browser and accesses a qualified server 12 therein
2 requesting data transfer. The server 12 provides login
3 account qualifier data requiring either user name and a
4 password 14 or a biometric interface 16 such as a retinal
5 scanner, finger print scanner, smart card reader and the
6 like for the purpose of seeking data-base authentication
7 18. If login fails, the user has three attempts 20
8 before the account is locked 22 and the administrator and
9 the account holder 24 is alerted. Upon a successful login
10 26, a transfer request 28 is sent to the control program
11 on the server to open a transfer information page inquiry
12 page.

13 Referring now to Figure 2, when data is to be
14 transferred 30, an applet is compiled on the server and
15 sent to the client 32. The applet is a temporary file
16 allowing the client to select 34 the data files that are
17 to be transferred. The user adds the file(s) to be
18 transferred to the application window 46. If the user
19 account allows, the client has the option of entering via
20 the keyboard, a secondary security key 36. It should be
21 noted that even if two separate people encrypted the exact
22 same file with the same key, they will have encrypted two
23 uniquely different sequences. If one attempts to "crack"
24 the application sequence, they would not be able to
25 decrypt it because each applet is embedded with a unique
26 encryption sequence. The encryption sequence generated is
27 added to the applet template and compiled 38 and
28 transferred to the server 40 with notification sent to the
29 recipient 42.

30 The applet breaks the code of the files down into its
31 binary form during execution. It reads the binary data
32 and then rewrites the data to the temporary file that was
33 previously created. The running program changes the
34 entire code sequence of the client file to a randomly

-10-

1 generated sequence specified by the particular and
2 customized applet. The sequence is also designed to
3 replace every other matching bit of binary code with a
4 unique string. Thus, with this method, an "a", for
5 example, will never be represented twice in the same file
6 structure. This is designed to deter the common method of
7 cracking encrypted code by repeated or pattern data. On
8 a binary level, the code is rewritten and saved for
9 transfer in a file format only decodable by the recipient.
10 The applet then sends the encrypted data to the server via
11 SSL protocol. Once the transfer is complete, the applet
12 deletes any trace of the file encrypted. With the
13 destruction of the applet, no two applications are ever
14 the same because each application contains it's own
15 encryption sequence that cannot be replicated.

16 The encrypted data resides on the server 12 waiting
17 for an intended recipient to download and unlock it. This
18 creates the ability to maintain completely encrypted and
19 secure data archives. When file retrieval is requested by
20 a recipient, the server then accesses the original record
21 information of the sequence or algorithm that it
22 originally gave to the applet that the server created to
23 encrypt the file.

24 Now referring to Fig. 3, shown is the flow chart
25 depicting the steps for decrypting data for a secure
26 receipt of electronic data. A recipient 50 opens a web
27 browser and accesses a qualified server 12 therein
28 requesting data transfer. The server 12 provides login
29 account qualifier data requiring either user name and a
30 password 52 or a biometric interface 54 such as a retinal
31 scanner, finger print scanner, smart card reader and the
32 like for the purpose of seeking data-base authentication
33 56. If login fails, the user has three attempts 58
34 before the account is locked 60 and the administrator and
35 the account holder 62 is alerted.

-11-

1 If the login is successful, the server 12 depicts
2 those files available to the recipient 66. The recipient
3 chooses which file to retrieve and the server generates a
4 new applet designed to decrypt the file requested 69,
5 based on the original encryption sequence. The file is
6 retrieved 70 and stored in a temporary file. The program
7 now prompts the user for any secondary key 71 that was
8 originally entered by the sender. Once the key sets the
9 sequence, the applet calculates the sequence that was
10 originally written on the fly. The applet resumes
11 decryption with the new sequence of the temporary file
12 wherein decryption is executed 72 and the decrypted file
13 saved to a selection location. When the data decryption
14 is complete, the program saves the file 73 with original
15 extensions, to a folder specified by the recipient. Then
16 the applet deletes itself 74 and any data related to the
17 secure transfer. Upon completion of the transfer and
18 decryption process, the original encrypted file located on
19 the server can be triggered to be automatically deleted or
20 retained for manual deletion.

21 It is to be understood that while a certain form of
22 the invention is illustrated, it is not to be limited to
23 the specific form or arrangement of parts herein described
24 and shown. It will be apparent to those skilled in the
25 art that various changes may be made without departing
26 from the scope of the invention and the invention is not
27 to be considered limited to what is shown and described in
28 the specification and drawings.

29
30
31
32
33
34

-12-

CLAIMS

What is claimed is:

Claim 1. A method of encrypting data for secure transfer and storage of electronic data comprising the steps of:

accessing a conventional web browser;

logging onto a qualified server and providing account
qualifier data;

reading a transfer information inquiry page upon
verification of account qualifier;

obtaining a first applet compiled on said server in response to said inquiry page, said first applet used to create a temporary file for the upload of data;

submitting a file for encryption to said applet;

encrypting said file and forming an encrypted data packet;

forwarding said data packet to said qualified server
for storage;

providing a means for decrypting said encrypted data packet.

Claim 2. The method according to claim 1 wherein said account qualifier is a user name and password.

Claim 3. The method according to claim 1 wherein said account qualifier is a smart card reader.

Claim 4. The method according to claim 1 wherein said account qualifier is a biometric interface.

Claim 5. The method according to claim 4 wherein said biometric interface is a retinal scanner.

-13-

1 Claim 6. The method according to claim 4 wherein
2 said biometric interface is a finger print scanner.

3

4 Claim 7. The method according to claim 1 including
5 the step of entering a secondary security key to said
6 applet.

7

8 Claim 8. The method according to claim 7, wherein
9 said secondary key is a digital file lock.

10

11 Claim 9. The method according to claim 1 including
12 the step of destroying said first applet.

13

14 Claim 10. The method according to claim 1 wherein a
15 recipient is notified of an encrypted data file by an e-
16 mail message sent via the open SSL protocol upon
17 submittal of said data packet to said server.

18

19 Claim 11. The method according to claim 1 wherein
20 said means for decrypting said encrypted data packet
21 comprising the steps of:

22 accessing a conventional web browser;

23 logging onto a qualified server and providing account
24 qualifier data;

25 reading a transfer information inquiry page upon
26 verification of account qualifier;

27 obtaining a second applet compiled on said server in
28 response to said inquiry page, said second applet used to
29 create a temporary file for the download of data;

30 submitting a file for decryption to said second
31 applet;

32 decrypting said file.

33

34 Claim 12. The method according to claim 10 wherein
35 said second applet is destroyed.

-14-

1

2 Claim 13. The method according to claim 1 wherein
3 said account qualifier is compared against a stored
4 database.

5

6 Claim 14. The method according to claim 1 said
7 encrypting of said file occurs during a transfer to said
8 server.

9

10 Claim 15. A method of encrypting data for secure
11 transfer and storage of electronic data comprising the
12 steps of:

13 accessing a conventional web browser;

14 logging onto a qualified server and providing account
15 qualifier data;

16 reading a transfer information inquiry page upon
17 verification of account qualifier;

18 obtaining a first applet compiled on said server in
19 response to said inquiry page, said first applet used to
20 create a temporary file for the upload of data;

21 submitting a file for encryption to said applet;

22 encrypting said file and forming an encrypted data
23 packet;

24 forwarding said data packet to said qualified server
25 for storage and destroying said first applet;

26 obtaining a second applet compiled on said server in
27 response to said inquiry page, said second applet used to
28 create a temporary file for the download of said encrypted
29 data;

30 decrypting said file and destroying said second
31 applet.

32

33 Claim 16. The method according to claim 15 wherein
34 said account qualifier is a user name and password.

35

-15-

1 Claim 17. The method according to claim 15 wherein
2 said account qualifier is a smart card reader.

3

4 Claim 18. The method according to claim 15 wherein
5 said account qualifier is a biometric interface.

6

7 Claim 19. The method according to claim 18 wherein
8 said biometric interface is a retinal scanner.

9

10 Claim 20. The method according to claim 18 wherein
11 said biometric interface is a finger print scanner.

12

13 Claim 21. The method according to claim 15 including
14 the step of entering a secondary security key to said
15 applet.

16

17 Claim 22. The method according to claim 21, wherein
18 said secondary key is a digital file lock.

19

20 Claim 23. The method according to claim 15 wherein a
21 recipient is notified of an encrypted data file by an e-
22 mail message sent by SSL protocol upon submittal of said
23 data packet to said server.

24

25 Claim 24. A system for secure transfer, storage and
26 access of electronic data comprising;

27 a software system program residing on a server having
28 a login entry sequence, means for generating a program
29 for encrypting data selected by a sender to create a first
30 applet, said first applet used to create a temporary file
31 on said sender's computer for the upload of data to be
32 transferred forming an encrypted data file, means for
33 transporting and storing of said encrypted data file,
34 means for generating a second applet to retrieve and

35

-16-

1 decrypt said data file, said second applet allowing for
2 the downloading and decryption of said data file.

3

4 Claim 25. The system according to claim 24, wherein
5 said applets are controlled by a user name and password.

6

7 Claim 26. The system according to claim 24, wherein
8 said sender selects a secondary private key to layer said
9 encryption.

10

11 Claim 27. The system according to claim 26, wherein
12 said secondary key is a digital file lock.

13

14 Claim 28. The system according to claim 26, wherein
15 said secondary key biometric interface.

16

17 Claim 29. The system according to claim 24 wherein
18 the recipient is notified of an encrypted data file by an
19 e-mail message generated by said system and directed to
20 said recipient.

21

22 Claim 30. The system according to claim 29 wherein
23 said e-mail is sent by SSL protocol.

24

25

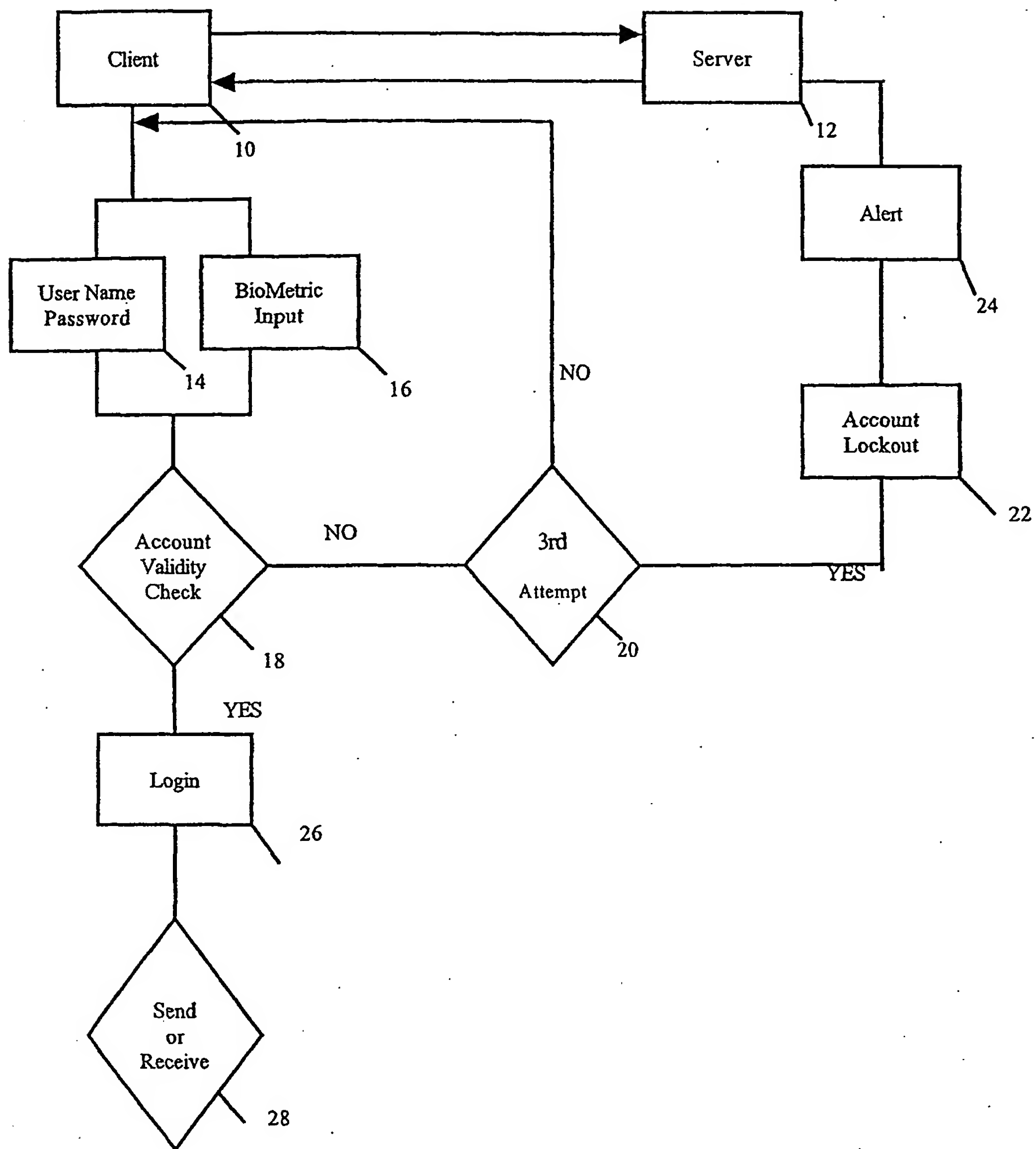


Fig 1

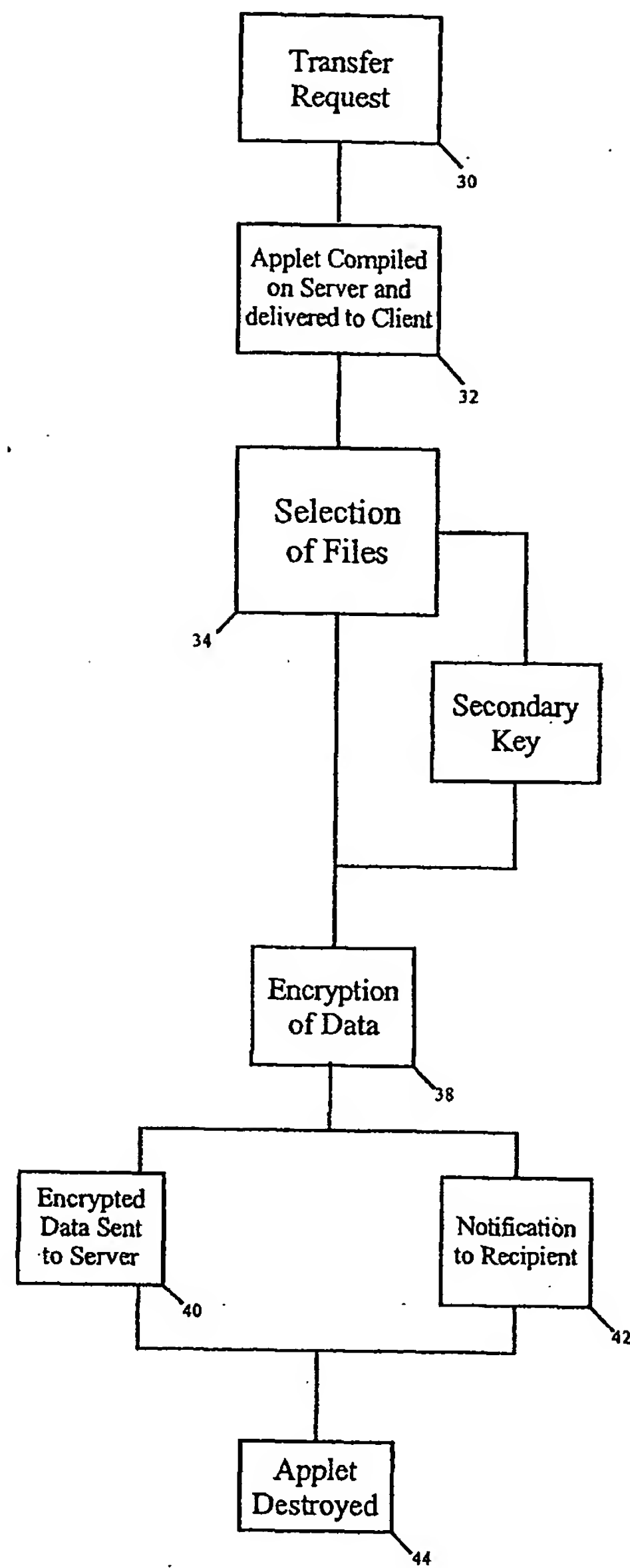


Fig 2

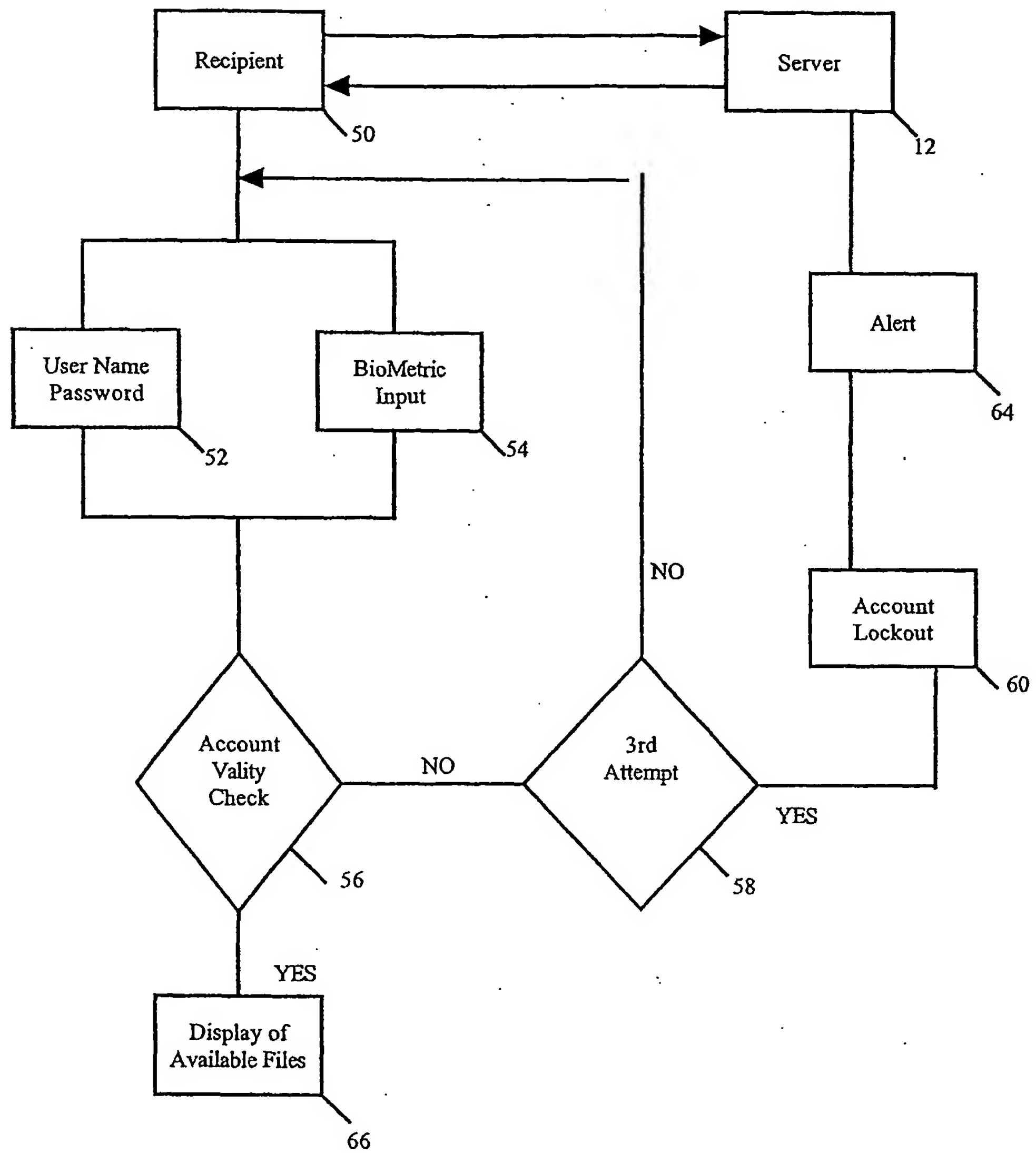


Fig 3

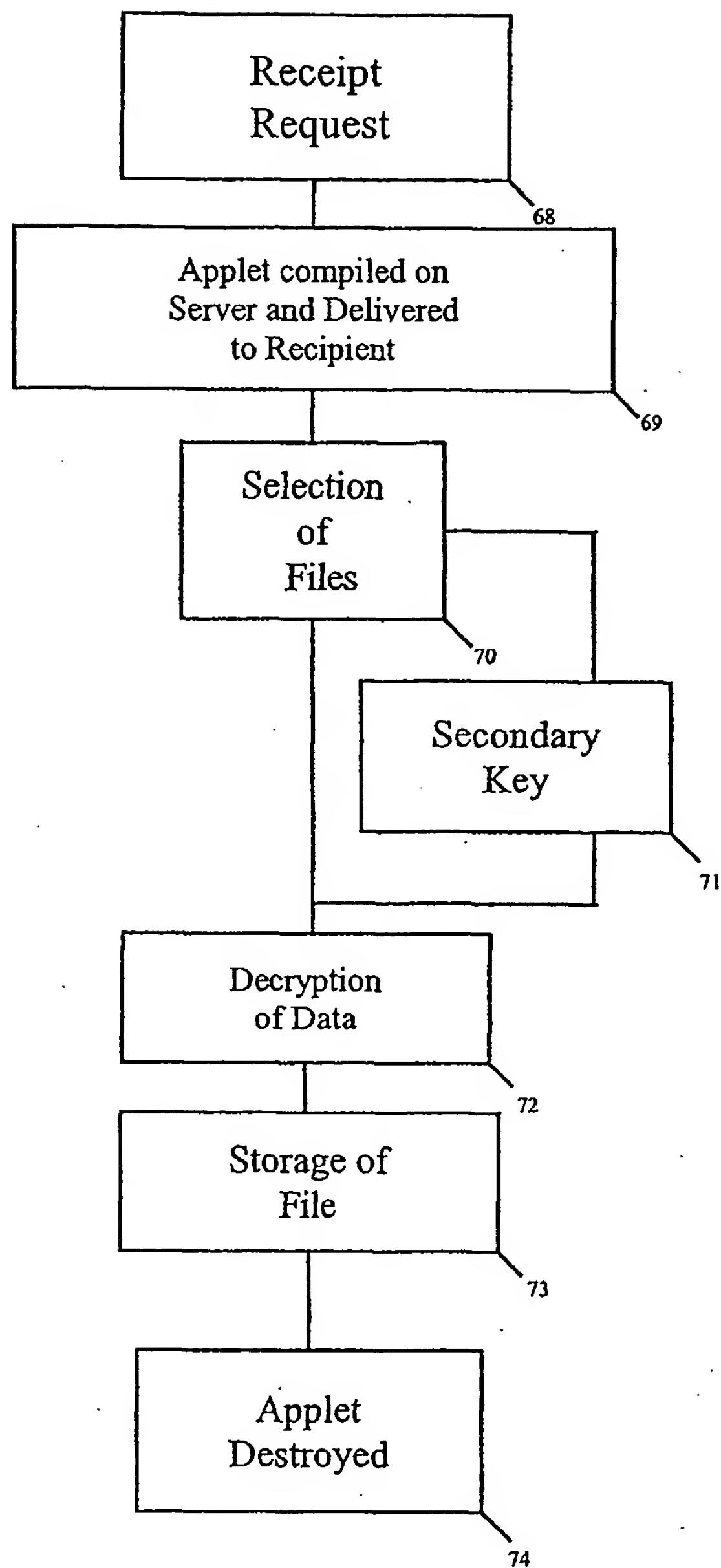


Fig 4.